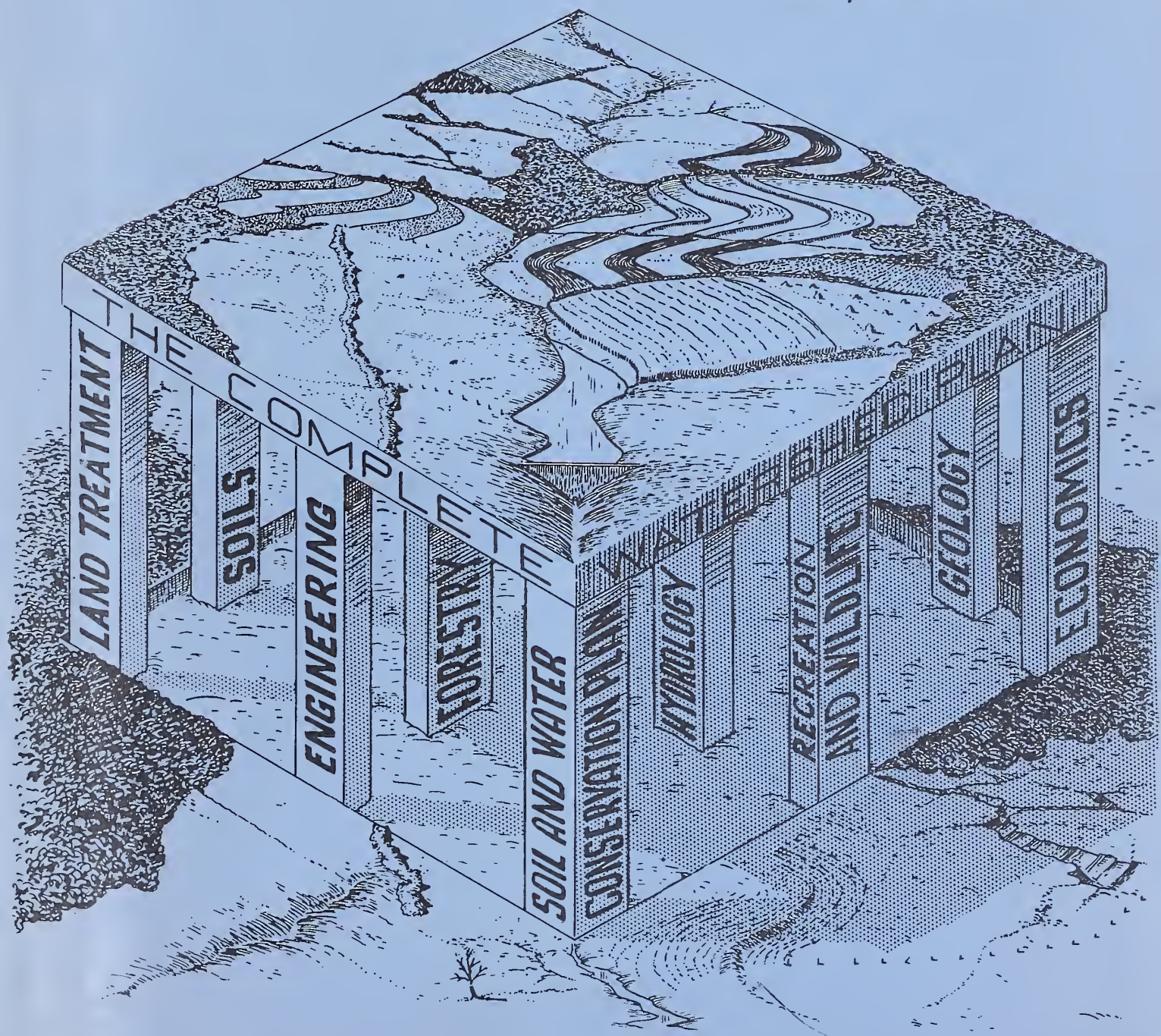
TTLE YADKIN RIVER
Watershed
Work Plan

FORSYTH, STOKES AND SURRY
COUNTIES, NORTH CAROLINA



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

WATERSHED WORK PLAN

LITTLE YADKIN RIVER WATERSHED

Stokes, Forsyth and Surry Counties, North Carolina

Prepared Under the Authority of Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended,

Prepared by: Little Yadkin River Watershed Improvement Commission
Surry Soil and Water Conservation District
Stokes Soil and Water Conservation District
Forsyth Soil and Water Conservation District

With assistance by:

U. S. Department of Agriculture, Soil Conservation Service

U. S. Department of Agriculture, Forest Service

JUNE, 1965

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Stokes, Forsyth and Surry Counties, North Carolina

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SUMMARY OF PLAN

This is a plan for watershed protection and flood prevention on the 40,000 acre Little Yadkin River Watershed. The Little Yadkin River originates on the south side of a ridge which extends from Pilot Mountain to the Sauratown Mountain. It flows south to its confluence with the Yadkin River in the northwest corner of Forsyth County.

The watershed is located in Stokes, Forsyth and Surry Counties, North Carolina. Nearly all of the watershed is privately owned and rural in nature. The majority of the farms are family farms, owner operated.

The plan was developed by the sponsoring local organizations which are: (1) Little Yadkin River Watershed Improvement Commission, (2) Surry Soil and Water Conservation District, (3) Stokes Soil and Water Conservation District, and (4) Forsyth Soil and Water Conservation District. The Soil Conservation Service and the Forest Service, of the U. S. Department of Agriculture, provided assistance under the provisions of Public Law 566, the Watershed Protection and Flood Prevention Act.

The population of the watershed is approximately 3,500; of which 2,000 are rural farm and 1,500 are rural non-farm. There are 443 farms within the watershed. One hundred eighty-nine of the farmers are soil and water conservation district cooperators. Approximately 37 percent of the watershed is in cropland, 47.4 percent is woodland, 9.9 percent is grassland, and 5.7 percent is miscellaneous.

Practically all of the 1,047 acres of flood plain is open crop or pasture land. These acres are used for agricultural production as intensively as possible under present conditions. Average annual flood damage to crops and pasture exceeds $17,000. Sediment deposits have damaged 124 acres.

Public roads and bridges are being damaged at the average of $900 annually. Floodwater damages to private improvements exceed $10,000 annually. In addition, the flood hazard retards development, prevents efficient use, and depresses land values.

This plan is designed to give relief from these conditions. Conservation land treatment will be emphasized during the entire eight-year installation

period. Land treatment cost is estimated at $628,813 (Table 1). Public Law 566 funds will pay $195,716 for accelerated technical assistance and $16,020 for cost-sharing of critical area treatment. The remaining $417,077 represents contributions by landowners for equipment, materials, and labor, as well as assistance from the Agricultural Conservation Program and other going programs.

The three floodwater retarding structures will provide 2,408 acre-feet of floodwater detention and control about 22 percent of the total watershed area. The estimated cost of installing the floodwater retarding structures is $414,005. Channel improvement by clearing and snagging is planned for 31 miles at a cost of $86,326.

The total cost of structural works of improvement is estimated at $500,331. Non-Federal cost amounts to $86,395. The total project cost is $1,129,144, of which $625,672, or 55 percent, will be P. L. 566 funds and $503,472, or 45 percent, will be other funds.

Planning, installation, and maintenance of land treatment measures will be performed by landowners or operators in cooperation with their soil and water conservation districts. Structural measures will be installed, operated and maintained by the Little Yadkin River Watershed Improvement Commission. The Soil Conservation Service will give technical assistance in farm planning and the installation of planned measures. Technical assistance for installing the forestry measures will be provided by the North Carolina Division of Forestry in cooperation with the U. S. Forest Service.

Average annual costs, including $3,125 for operations and maintenance, are $19,516. Average annual benefits are $36,471. This gives a benefit-cost ratio of 1.9 to 1.0.

DESCRIPTION OF WATERSHED

Physical Data

The Little Yadkin River Watershed, consisting of 40,000 acres, is located in Stokes, Fortyth and Surry Counties, North Carolina. Approximately 36,600 acres are in Stokes County, 1,100 in Surry County and 2,300 in Forsyth County.

The stream originates on the south side of a ridge which extends from Pilot Mountain to the Sauratown Mountain. It flows south to its confluence with the Yadkin River in the northwest Corner of Forsyth County.

The principal upland soils are members of the Cecil, Hartsells, and Wilkes series, with a small amount of rough stony land. The soils are developed chiefly from schists and gneiss. They are generally 30 inches deep on the smoother areas and shallower on the steeper areas. Flood plain soils are members of the Congaree and Chewacla series.

About 75 percent of the watershed has been in cultivation. As the land became seriously eroded, it was abandoned and has reverted to trees. Presently land capability classes I, IIe and IIw account for 27 percent of the cropland and classes IIIe, IVe, VIe and VIIe account for 73 percent. Nearly one-third of the existing cropland has a severe erosion problem. More than 60 percent of the pasture land is in capability classes VIe and VIIe.

Approximately 37 percent of the watershed is in cropland, 47.4 percent is woodland, 9.9 percent is grassland, and 5.7 percent is miscellaneous. Cover conditions are poor. The climate is excellent for agricultural purposes. Temperatures vary from extremes of 104 degrees Fahrenheit to 39 degrees and the summer is 74 degrees. Normally, the growing season is 175 days. Rainfall is well distributed throughout the year and averages about 47 inches.

The Little Yadkin River Watershed is located in the western edge of the Piedmont physiographic province. According to the geologic map of North Carolina, the larger part of the watershed is underlain by rock of the King Mountain group which is composed of folded and faulted upper precambrian or early paleozoic sediments. The southeastern one-third of the watershed is underlain by mica gneiss and mica schist of precambrian age. The Kings Mountain group is composed of quartzite, marble, conglomerate, and schist.

The dip of the rocks varies considerably from place to place; however, the strike is generally southwestward. The Sauratown Mountain, forming the northern boundary of the watershed, is capped by several hundred feet of quartzite. The quartzite generally dips to the north and northwest, forming steep cliffs that face the southeast.

The topography of the watershed is rolling to mountainous. The more level areas are located in the east central part of the vicinity of King. The lowest protected flood plain elevation is 770 feet. The highest elevation in the watershed is 2,470 feet on the top of Sauratown Mountain. Gently rolling areas on the upland are small; they are narrow flat top ridges between drainage basins. The stream valleys alternate between narrow gorge-like sections and reaches of fairly wide flood plain. Most of the channels are on bedrock; rock overfalls in the channels are common throughout the watershed.

All of the land except that occupied by public roads and buildings is privately owned.

Surface waters of this watershed are used for agricultural purposes such as irrigation and livestock. Water for human use is obtained from deep wells. Existing lakes and reservoirs are limited to farm ponds of small size.

Wildlife of the area is that which is normal to Piedmont North Carolina and consists of squirrel, rabbit, fox, raccoon, quail, and an occasional turkey and pheasant. Fish are limited to non-game varieties.

Economic Data

There are about 443 farms within the watershed. These farms vary in size from ten to several hundred acres, with the average size being 75 acres. The average value of a farm is about $10,000. There are also 60 homesteads of ten acres or less on which some part-time farming is done.

The majority of the farms are family farms, owner operated. Only 36.3 percent of the farms are tenant operated and most of these are family size operations. Tobacco harvesting accounts for the greater part of the seasonal hired labor. The practice is to hire available labor from neighboring farms or villages for crop harvest. About five percent of the farms employ one and one-half man-years or more of labor. Most of these farms are commercial poultry and egg operations.

The average annual gross sales per farm from crops and livestock is $4,000, which produces a net income of about $1,900. Twenty-two and one-half percent of the farms in the watershed have gross farm sales of less than $2,500; and a net income of $1,200 or less. Often, one or more members of the farm family work in the nearby industries to supplement the low farm income. The median family income is $3,240. Only three percent of the families exceed $10,000 per year, while 48 percent make less than $3,000.

Until about 1940 more than 50 percent of the watershed was used for cultivation. Corn, cotton and tobacco were the principal crops. In recent years, the severe erosion and steep land has forced a large percent of the landowners to seek other employment and use their farm land for tobacco production and livestock.

Cash sales are now limited almost entirely to tobacco and livestock products. Very little of the 6,900 acres of corn grown in the watershed is marketed. Crops account for 90.7 percent of the sales and livestock 9.3 percent.

The trend is toward fewer and larger farms. There was an 18 percent decrease in the number and an 8.4 percent increase in the size of farms between 1954 and 1959.

Expenditures for hired labor increased 53 percent, fuel 80 percent, feed 30 percent, and machine hire 23 percent.

The commercial farms in the watershed are classified according to the 1959 U. S. Agriculture Census as follows:

Class of Farm	Value of Farm Products Sold	Percent
I	$40,000 and over	0.0
II	$20,000 to $39,999	0.2
III	$10,000 to $19,999	1.8
IV	$5,000 to $9,999	17.8
V	$2,500 to $4,999	57.7
VI	$50 to $2,499	22.5

Flooding constitutes an important reason for many of the social and economic problems confronting this area. About one-fourth of the farms in the watershed have flood plain lands that are subject to flood damages. Owners and operators are forced to use marginal uplands due to the flood hazard of the fertile bottomlands.

With flood prevention, the flood plain soils could be used intensively with little additional associated cost. Most of the flood plain land is well drained to imperfectly drained. There is practically no need for drainage on the upland soils.

Since a continuous supply of available moisture is necessary for good plant growth, there is a need for additional irrigation systems in the production of the high value crops. With proper design and planning, sufficient water would be available from flowing streams.

Forest land covers 18,960 acres of the watershed. The forest land occupies the steeper land with 54 percent on slopes of ten percent or more. The forest types are pine, 34 percent; mixed hardwood and pine, 40 percent; and hardwoods, 26 percent. The major species are Virginia, short leaf and pitch pines, mixed oaks, hickory, and yellow poplar. Thirty-two percent of the forest land is medium to poor in stocking. Pine volumes average 1,860 board-feet per acre and hardwoods 480 board-feet per acre. Cubic feet volume of pole size timber averages 300 of pine and 190 for hardwood.

The area has a history of forest land grazing, wildfires, overcutting, and cultivation of areas that are now forested. This has decreased the infiltration rate of the soils. Forty-six percent of the forest land has been cultivated in the last 50 years. Grazing is no problem of the present time and the trend is toward improvement of the woodlands.

King, population 2,500, the largest community in the watershed and second largest in the county, is unincorporated. King began to develop as a trading center around 1840. Its close proximity to Winston-Salem (about 18 miles away via four lane highway) has resulted in residences in King by people who commute to Winston-Salem to work. Local industries include Hastings Automotive Parts Company, King Lumber Company, Slate Lumber Company, King Hosiery Mill, and Custom House Draperies.

Pinnacle, a community of 500 to 600, is the second largest in the watershed. It has a shopping center and serves as a trading area for the watershed. It is also located on U. S. Highway No. 52.

The area is well served by the Southern Railway and good highways. The main roads are U. S. Highways Nos. 52 and 52-A, and North Carolina Highways Nos. 65, 66 and 268. There is also a good network of farm-to-market roads.

The population of the watershed is approximately 3,500; of which 2,000 are rural farm and 1,500 are rural non-farm. The majority of the rural

non-farm population live along U. S. Highway No. 52-A and North Carolina Highway No. 66. The population increased 3.7 percent between the years 1950 and 1960, although there was an out migration of approximately 350.

Employment opportunities exist in the nearby industries. This is an area of industrial expansion. The North Carolina Employment Security Commission estimates that approximately 100 recruitable workers are available within the watershed. Unfortunately, many young adults leave the area and move to where opportunities are greater. Twenty percent of the farm operators work at off farm employment 100 days or more annually. However, off farm income exceeds farm income for 23 percent of the farm families.

Fifteen cities and towns, with a combined population of 150,000, and 100,000 rural and rural non-farm people are within easy driving distance of the proposed dam sites. U. S. Highway No. 52 offers four lane accessibility. Planned facilities, with proper maintenance, would compliment the existing recreational attractions.

Hanging Rock State Park, adjacent to the watershed, is a 3,865 acre expanse of rugged terrain on the Sauratown Mountain. It is four miles northwest of Danbury and 32 miles north of Winston-Salem and accessible over paved North Carolina Highways Nos. 89 and 66. The park has a large bathhouse of native stone, and a swimming, fishing and boating lake. Fishing season begins about May 1. The lake is stocked with bass, bream, and shellcrackers. Also available are camping areas, picnic facilities and cottages for rent. Pilot Mountain, near U. S. Highway No. 52, is partially developed as a scenic tourist attraction.

Adequate facilities for tourist meals and lodging exists in the area, or within easy driving distance of the watershed.

Land Treatment Data

The soil and water conservation districts have been carrying on an active program utilizing P. L. 46 and any other available assistance under similar going programs. There are 189 farmer cooperators in the watershed area; of these, 149 farmers have developed soil and water conservation plans on their farms. These plans cover 12,400 acres or about 31 percent of the watershed area. Approximately one-half of these plans need updating.

Approximately 56 percent of the planned soil and water conservation practices have been applied to the farms which are cooperating with their soil and water conservation districts. The establishment of these practices has resulted in 3,000 acres of open land being properly treated. About 2,050 acres of open land on non-cooperator farms have been properly treated. Landowners have expended an estimated $350,247 to treat these acres.

Land treatment practices applied are effective in reducing erosion on those acres properly treated. A further reduction in active erosion has been accomplished by the change from row crops to pasture and hay which has taken place in recent years. The soil and water conservation district

supervisors anticipate that further reductions in erosion can be expected.

WATERSHED PROBLEMS

Floodwater Damage

Thirty-three storms caused flooding during the 16-year evaluation period. The largest storm in the series estimated to be a 25-year frequency, occurred on September 17, 1957. This storm flooded 928 acres of the flood plain and caused damages in excess of $20,000. The second largest storm occurred June 12, 1962 and even though it only flooded 568 acres, damages were equal to the September 1957 storm. The high damageable values in the height of the growing season accounted for the intense losses in the June 1962 storm.

There are 1,047 acres of flood plain land within the watershed and 344 acres just below the watershed that are subject to be damaged by uncontrolled floodwaters of the Little Yadkin River. Damageable values per acre of crops and pasture vary from a low of $5 in December to a high of $55 in July. The average monthly damageable value is $23.

Present land use in the flood plain is primarily corn, corn silage, tobacco, and pasture. Landowners state that after the project is installed, considerable acreage of tobacco and other high income producing crops will be shifted from the erosive hillsides to the flood plain.

Spring floods delay land preparation and planting on the flood plain lands. Those floods which occur after the normal planting time make it necessary to prepare a new seed bed before replanting. This often results in increased cost of production and reduced yields. After normal time of planting, farmers are forced to substitute a short-season for a more adapted full-season variety.

About 35 percent of the flood events recorded occurred in the growing season. The extent of floodwater damages for a particular event depends on the depth, duration, velocity of flow and sediment load of the floodwaters. About 30 percent of the storms occurred during the harvest season. As a result of the summer and fall storms, farmers harvest a lower quality product and receive lower prices for the damaged goods.

Public roads and bridges sustain considerable floodwater damage from the larger floods. The damage consists of the scouring of the shoulders, silting of road drainage ditches, washing away segments of earthfill, and the washing off of surface gravel. The damage occurring to the bridges includes damages to the abutments and approaches. Public roads and bridges are being damaged at the average of $900 per year.

Floodwater damages to private homes, roads, bridges, fences, and buildings exceed $10,000 annually. The repairs of damage occurring to 30,000 feet of fences consist of removal of debris, repairing segments, or complete

replacement. Often the cost of repairing is as expensive as constructing a new fence. It is also recognized that accelerated depreciation is an additional damage to fences. Silt and debris has to be removed from 12,000 feet of open ditches that are subject to flood damage. The abutments and approaches to 20 farm bridges are often damaged, even if the bridges are not washed away or destroyed.

Efficient use of flood plain land under present conditions make it essential that these fixed improvements be properly maintained. Annual costs of repairs necessitated by frequent flooding are a significant item in annual farm operating costs. In spite of the fact that the flood hazard depresses land values, the average value of agricultural flood plain land is $300 per acre. Other land ranges in value from $100 to $1,000 per acre.

Some of the indirect damages occurring are: (1) disruption of traffic, (2) delay of mail service and school bus service, (3) inconvenience to traveling public, (4) interruption of the management, feeding, and marketing programs of the farmers, and (5) losses sustained by businesses in the area.

Sediment Damage

Infertile overbank deposition is now occurring on approximately 124 acres of crop and pasture land annually. Investigations show that production on these acres is approximately 15 percent less than that on the undamaged acres.

Sediment production is heavy on flood plain land throughout the watershed and a large volume of sediment is delivered to the channels annually. However, very little land has been damaged by swamping. Stream gradients are relatively steep, 20 to 40 feet per mile, and much of the sediment is transported out of the watershed. Several sand dipping operations have further reduced channel fill.

The most frequently flooded areas are subject to the heaviest sediment damages and are generally found in bands paralleling the stream channels. These areas are usually in land use which produce low returns. Landowners cannot economically use this land more intensively until floodwater and sediment damages have been reduced.

Damages from infertile deposition have decreased considerably in the past 30 years. This has come about by more conservation practices applied on cropland and by a large acreage of the severely eroding land returning to woods.

The average annual sediment damage to flood plain land is $1,840 per year.

Erosion Damage

The field investigation of more than 50 percent of the flood plain and stereoscopic study of the entire flood plain area revealed that only a few

small, widely scattered areas have been damaged by flood plain scour. Damages from this source were considered to be too minor to merit evaluation.

Sheet erosion is still the main source of sediment causing downstream damages. At present, the average soil loss from sheet erosion is nearly four tons per acre per year. Some cultivated fields are losing soil at a rate higher than 30 tons per acre per year. This is more than seven times the allowable rate of erosion for most of the soils in the watershed. A detailed erosion study on three sample areas, comprising 23,000 acres, showed that the watershed is losing about 141,000 tons annually.

Roadbanks and the few small critically eroding areas are causing 41,000 tons of soil movement each year. This erosion contributes to downstream damages out of portion to its size since so much of the material is delivered directly into the channels.

It is estimated that on the average 75 percent or more of the topsoil on the open upland soils has been removed by past erosion. A large portion of the once cultivated upland has returned to woods by natural reseeding, and the rate of erosion and soil movement has decreased.

The woodland cover, except for a few small areas, is fair. This helps to minimize erosion and soil movement, but it is less than satisfactory in its hydrologic effectiveness in reducing storm runoff.

Active large gullies were widespread in years past; however, most of these are stabilized. Critical areas are now limited to a few small scattered spots. Untreated roadbanks are a major source of sediment.

An inspection of the channels showed the banks are stable and the stream beds are nearly in equilibrium. In many places the channels are down to hard rock. In a few instances, where tree tops and logs have caused blocking, sediment is being deposited in the channels. Soil conditions in the banks are such that if the heavy growth is cleared off, bank erosion may become serious.

It is estimated that erosion has decreased the natural productivity of the upland soils by at least 40 percent.

Land Treatment

Improper use of the sloping erodible lands has given rise to a number of problems. As the fertility of the land decreased, farm incomes dropped. On the smaller farms, and especially those on the steeper lands, the old conventional row cropping no longer paid enough to support a family. Tobacco allotments are small, and most landowners have been forced to seek outside industrial work. Tobacco is produced in off-duty hours. Much of the open land has been released from row crop production. These acres must be converted to grassland, woodland, apple orchards, and other uses which will protect and preserve the soil. Funds from the sale of tobacco and industrial employment are adequate to enable landowners to make conversions

and install needed land treatment measures. This trend should increase the number of livestock and provide sound, long-time investments in woodland products.

Many of the good crop-producing bottom fields have never been used to their full potential because of the flood hazard. This danger will be reduced after the structural measures are completed and the land treatment practices established. The production of high-income-producing truck crops such as beans and tomatoes can be greatly expanded on these fertile fields. In addition, tobacco plantings can be removed from the eroding uplands and planted on these better land classes. The acreage of tobacco is controlled by allotment.

Eroding roadbanks and ditches are prevalent. These unsightly situations are major sources of silt which muddy and clog downstream areas. The establishment of vegetation on these areas is of prine impprtance. The job of planting the many miles of roadbanks will present a difficult task.

All of these changes in the agricultural picture of the area are necessary for more efficient use of the land, labor, and capital, and an improvement of low farm family incomes.

Problems Relating to Water Management

Practically all of the flood plain is adequately drained for the production of crops, and with the exception of an occasional spring head, all upland is well drained.

There is a need for additional irrigation systems in the production of tobacco and truck crops. With proper design and planning of irrigation systems, sufficient water is available.

Water for agricultural domestic use presently comes from deep wells. Hanging Rock State Park is located adjacent to the watershed; however, there is an almost total lack of parks and playgrounds within the watershed. Present private and public recreational areas are overcrowded. A definite need exists for water based recreational facilities.

PROJECTS OF OTHER AGENCIES

There are no known existing or soon to be constructed works of improvement for water resource development which will affect or be affected by works of improvement included in this plan.

The U. S. Army, Corps of Engineers, has proposed a reservoir and dam, the dam to be at mile 277. Full pool of the proposed reservoir has been set at an elevation of 720 feet msl. An alternate project, known as the Styers Project, is located about 20 miles below the mouth of the Little Yadkin River. Full pool elevation of this project has been set at 750 feet msl.

As the lowest flood plain land in the Little Yadkin River Watershed is at elevation 770 feet msl, the Styers Project would not affect this work plan.

BASIS FOR PROJECT FORMULATION

The sponsoring local organizations realize that if the watershed area is to remain in agricultural use that soil and water conservation measures must be applied. They further realize that land use adjustment must be made by utilizing flood plain lands more intensively and reducing the load on uplands.

The land lying within the boundaries of the Little Yadkin River Watershed is rolling to mountainous. Through the years, farming the steep hillsides has taken a tremendous toll of the topsoil. Many acres of land are still being mistreated. Soil loss and downstream sedimentation is severe. Most of the land is not suited to row crop agriculture. Its productive future lies in a shift toward grassland, woodland, recreation, orchards, and similar uses.

An appraisal of the present land conditions and the future land treatment needs of this project has been made. It was found that of the 40,000 acres in the watershed, 18,750 acres are in open land (crops, idle, hay and pasture), 18,960 in woodland, 302 acres in badly eroding critical areas and the balance in miscellaneous use. Of the 18,750 acres of open land, 5,050 acres have adequate treatment, while the remaining 13,700 acres require treatment. Erosion is taking a heavy toll on 2,050 acres of cropland located on the steeper slopes. This land should be converted to woodland, grassland or other uses suited to land capabilities. This will mean a reduction in acres of surplus crops.

In order to install this required land treatment, it will be necessary to establish conservation cropping systems with one-half, two-thirds, and three-fourths in soil conserving crops, depending on the land capability. Of the 13,700 acres needing treatment, row crops such as corn and tobacco can be grown on only about 6,000 acres annually.

The woodland aspect has been analyzed as follows: of the 18,960 acres now existing, 10,600 acres are being adequately treated and the remaining 8,360 acres will need treatment. In addition, 1,195 acres of new plantings will need to be established.

From the foregoing facts, the sponsors understand the magnitude of the job ahead. They realize that changes in land use, coupled with good land treatment, are inevitable and necessary for the future well-being of the people in this area. They believe that the watershed project approach to this situation will not only stimulate this trend, but will, in fact, make it possible within the foreseeable future.

The control of sediment and high runoff from denuded and severely eroding areas is one of the major objectives of the sponsoring local organizations. They have set as one of their goals the vegetation of all eroding road-banks on paved roads and all critical eroding areas on farmland.

The sponsoring local organizations and the Soil Conservation Service have set their objectives for flood prevention at a level which will provide five-year protection to most of the flood plain. Floodwater retarding structures and clearing and snagging of stream channels were evaluated to determine the combination of these measures which would meet project objectives. Water based recreation facilities were evaluated. Cost data was developed and benefits were estimated. However, after careful consideration, the sponsoring local organizations decided that they did not desire to include recreation facilities in the watershed work plan.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

As indicated in Table 1 of the Watershed Work Plan, 7,229 acres of cropland, 2,175 acres of grassland, and 302 acres of miscellaneous land will be given some type of conservation treatment during the installation period. Much of the steep and badly eroding land now in row crops (class VIIe, VIe, and some IVe land) will be converted to pasture or trees. On the remaining cropland, a combination of soil conservation measures will be established. Emphasis will be placed on rotations with long intervals of close-growing crops. For the years when row crops are planned, the use of crop residues and contour tillage will be stressed. Terraces, field borders, diversions, and grassed waterways will be installed as needed. All of these conversions and conservation measures will reduce erosion and alleviate the pressure of row crops on the upland fields. The end result will be a reduction in the acreage of surplus crops.

The forest land treatment measures and the continuous care of established stands will reduce runoff and prevent erosion. Forest litter produced under proper forest management and protection is the source of a good humus layer needed to increase infiltration rates and water storage capacity. Favoring desirable species for humus buildup during cutting operations will assure the development of well-aggregated soils and maintain a desirable humus layer.

The recommended measures are:

1. Tree Planting (Critical Area)

   About 200 acres of open, critically eroding lands will be stabilized by planting to trees. Loblolly pine or other soil stabilizing species will be used. This treatment will increase the rate of water intake and detention storage

capacity. This will result in retarding runoff and reducing soil and sediment to a minimum. Site preparation and fencing are included in the measures when required to assure success of tree planting.

2. Other Measures (3,535 acres)

This includes open land tree planting, underplanting, interplanting, removal of inferior species and cull trees and improvement, release and harvest cutting.

Much of the present pasture land where sheet erosion is taking place will require better pasture management or complete replanting to provide better protection cover. Proper pasture use is a practice which the landowners will carry out on at least three-fourths of the pasture land.

The main function of vegetation on critical areas will be to stop the erosion. On areas other than roadbanks, plant species can be used which will provide future use for wildlife or woodland products.

In order to plan the necessary land treatment measures, adequate soils information will be needed. It has been found that such information is lacking on some 25,000 acres in the watershed. It will require about 1,500 man-hours of technical assistance provided by the Soil Conservation Service to complete this soil survey.

Structural Measures

Three floodwater retarding structures are planned as shown on the watershed project map. Each structure will be an earthfill dam with a fixed drawdown tube and a vegetated emergency spillway. A reinforced concrete riser will set the elevation of the sediment pool and a metal slide headgate will be located near the bottom of the riser so that the sediment pool can be drained. All embankments, earth spillways, borrow areas, and other areas disturbed in construction (except within the sediment pool area) will be vegetated. Design data for these structures is shown in Table 3. A typical cross section of a floodwater retarding structure is shown in the Investigations and Analyses section of this plan.

These structures will provide 2,408 acre-feet of floodwater detention capacity and will control 21.9 percent of the watershed area. The floodwater detention capacity is equivalent to 3.30 inches of runoff from the area above the structures, or .72 inch from the entire watershed area. The structures will also provide 1,867 acre-feet of sediment storage which is 2.55 inches from the drainage area controlled.

The estimated cost of installing the floodwater retarding structures is $414,005.

Clearing and snagging is planned for 163,650 feet of stream channels. It will consist of removal of logs, stumps, debris, and overhanging trees

which will probably fall into the channel in the next five years (see project map for locations). The estimated installation cost is $86,326. Design data for channels is shown in Table 3A.

The average annual cost of structural works of improvement, including operation and maintenance, is $19,516. A breakdown of measures, quantities, and distribution of installation costs between P. L. 566 and other funds is shown in Table 1.

EXPLANATION OF INSTALLATION COSTS

The estimated installation cost is $1,129,144, of which $625,672, or 55.0 percent, will be P. L. 566 funds and $503,472, or 45.0 percent, will be other funds. The schedule of estimated installation cost by project years is shown at the end of this portion of the narrative.

It is estimated that it will cost $628,813 (Table 1) to install all the land treatment measures.

The landowners will provide $4,080 in money, materials or services in kind (Table 1), which will equal or exceed 34 percent of the cost of applying the critical area stabilization (grasses and legumes). P. L. 566 funds will provide $6,120, or 66 percent. Roadside erosion control will cost $12,750. The Little Yadkin River Watershed Improvement Commission will negotiate with the North Carolina State Highway Commission the sharing of the cost of roadside erosion control. Landowners of cropland and grassland will apply conservation measures which will cost $346,682. The accelerated technical assistance, including soils mapping furnished by the Soil Conservation Service from P. L. 566 funds, amounts to $185,296 and the present soil and water conservation district program will provide $11,755 from P. L. 46 funds.

The total cost of the forest land treatment program is $62,130. Of this, $20,320 are P. L. 566 funds, and $41,810 are from other funds. The P. L. 566 funds include $9,900 for critical area stabilization and $10,420 for accelerated technical assistance. The North Carolina Division of Forestry will provide $5,100 for technical assistance. This includes $4,700 for accelerated technical assistance from State funds, and $400 through the going Cooperative Forest Management Program.

Other funds provide $34,210 for the land treatment measures on private land. These other funds are furnished by the individual landowners and operators concerned and include the cost-sharing available through the Agricultural Conservation Program.

The total cost of structural works of improvement is estimated at $500,331. Non-Federal costs amount to an estimated $86,395. These costs are described as follows: (a) Land, easements and rights-of-way, $83,895; and (b) Administration of Contracts, $2,500. The Little Yadkin River

Watershed Improvement Commission will secure the necessary land, easements and rights-of-way and will let, bear the cost of, and administer contracts.

P. L. 566 costs will amount to $413,936. Construction costs will amount to $323,893; engineering services, $64,779; and other costs $25,264. An allowance of 12 percent was made in the construction cost for contingencies.

SCHEDULE OF ESTIMATED INSTALLATION COST

The following summarizes the construction schedule and the estimated installation costs of the project by years:

Year	P. L. 566 Funds	Other Funds	Total Funds
First	26,000	64,000	90,000
Second	28,000	64,000	92,000
Third	28,000	64,000	92,000
Fourth	36,000	64,000	100,000
Fifth	373,275	133,290	506,565
Sixth	90,271	49,055	139,326
Seventh	24,000	33,000	57,000
Eighth	20,126	32,127	52,253
Total	625,672	503,472	1,129,144

EFFECTS OF WORKS OF IMPROVEMENT

Land treatment will reduce overbank sediment deposition approximately 35 percent annually. This reduction will occur throughout the watershed. Flood plain land not protected by floodwater retarding structures will experience noticeable reduction in the deposition of infertile sediment.

Another ten percent reduction in sediment deposition will accrue from the stabilization of the roadbanks and the few small scattered areas of gullied land. Roadbanks, while small in the total area, are the source of considerable sediment. In many instances, the road ditches empty directly into the streams or on the flood plain.

The three floodwater retarding structures will reduce the total overbank sediment deposition about 15 percent. Reaches immediately below structures will be nearly free of overbank deposition.

Very little sediment is now being deposited in the channels. In many instances the streams are flowing on hard rock. Tree tops, longs, and other blocks cause some localized deposition in the channels. Removal of these blocks will practically solve all channel deposition problems.

It is estimated that future land treatment will reduce soil loss about 30 percent and land stabilization will reduce soil loss about ten percent.

The establishment of full tree cover on open areas of eroding land will largely eliminate the damaging surface runoff and sediment loads which originate on such areas. Installation of the hydrologic stand improvement measures prescribed in the work plan will decrease damaging storm runoff from forest areas. These areas will also function as demonstrations of effective woodland management to landowners in the watershed. Under good management, forest lands of the watershed will produce an average merchantable volume two to four times greater than at present.

The number of flood producing storms in the 16-year historical series will be reduced from 33 to seven for the area below floodwater retarding structures. This same area will have flood free protection for the two-year frequency storm and the area flooded by the five-year frequency storm will be reduced by 90 percent.

There are 202 acres of flood plain land on Danbury Creek and Upper West Prong where only stream channel improvement is proposed. Approximately 135 of these acres will be free from flooding for a 5-year frequency storm. The remaining 67 acres, which are generally near the channels, will flood more frequently.

Acres flooded by the maximum storm in the historical series will be reduced by 50 percent for the area below floodwater retarding structures. Since this storm occurred on a high antecedent moisture condition the volume of runoff will be reduced by five percent as a result of land treatment measures. Runoff from the same storm, with an average antecedent moisture condition, would be reduced by ten percent by land treatment measures.

The proposed structural program will benefit 1,047 acres of flood plain land within the watershed, and 344 acres of flood plain along the Yadkin River just below the project. Benefits to flood plain land outside the watershed were not evaluated.

There will be no increase in the acreage of cropland in the watershed. Many needed land use adjustments will be made so that much of the land will be used according to its capabilities and treated according to its needs. The project will enable the landowner to grow more row crops in the flood plain, which will allow an opportunity to establish better conservation cropping systems on the eroding uplands. As a result of the project, 950 acres of the flood plain land can be used more intensively. This will improve the economy of the family farm system.

About 100 rural families who own or operate flood plain land will receive direct benefits from the structural program. Crop and pasture damages will be reduced 95 percent; fixed improvements damage, 88 percent; and indirect damage by 92 percent. As a result of the improved land treatment, farm ponds will receive less sediment, stay cleaner, and will produce more fish.

The reduction in the number, duration and magnitude of the floods will: (1) help in making some needed land use adjustments, (2) enable farmers to

use the productive flood plain more intensively, (3) greatly reduce the extent of present crop and pasture damages, (4) reduce sediment and scour damages, (5) permit essentially uninterrupted travel throughout the watershed, (6) reduce the amounts of maintenance work to roads, bridges, and fixed improvements, (7) create new job opportunities, and (8) increase economic opportunities for low-income families in the area. Installation of planned works of improvement will accomplish the stated objectives of the sponsoring local organizations.

The lakes created by the three sediment pools will provide opportunity for picnicking, swimming, fishing, water skiing, and boating. Sponsors and landowners have stated that organized groups and the general public will be encouraged to make maximum use of the recreational potential.

Temperatures in this area permit swimming and water skiing from May to October. With the exception of a few days of cold, bad weather in the winter, boating and fishing can be enjoyed year-round. Peak seasons of use would be from Memorial Day to Labor Day.

A population of 150,000 in cities and towns and 100,000 non-urban people live within easy driving distance of the recreational facilities. With planned facilities and proper maintenance of each site, a total of 2,160 user-days per year for the three lakes is a conservative estimate.

Secondary benefits from a national viewpoint were not considered pertinent to the evaluation. Local secondary benefits will accrue as a result of increases in the sale of agricultural products and increased income to local processors, business establishments, and others not directly benefited. These local secondary benefits also include the transporting, processing, and marketing of these goods and services that produce the primary benefits, and the supply of additional materials and services required to make possible the increased net returns which stem from installation of the project.

PROJECT BENEFITS

The average annual floodwater damage to crops, pasture and fixed improvements is estimated to be $34,282. The installation of the planned works of improvement will reduce these damages to an estimated $2,904 annually. Estimated benefits from flood damage reduction amounts to $31,378 (Table 5), or a 92 percent reduction in damages. These benefits consist of reduction in crop and pasture damage amounting to $17,325 ($13,225 is restoration to former productivity); fixed improvements, $9,700; sediment, $1,500; and indirect damage, $2,853.

Estimated total average annual benefits from installation of the structural works of improvement amount to $36,471 (Table 6). These consist of flood damage reduction benefits, $28,378; more intensive land use benefits, $5,000; and secondary benefits, $3,093.

In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $3,000 annually. It is expected that land use changes will be made on uplands so that it will be used according to its capability class. Under the program, forest land will increase by 1,195 acres, or six percent. The overall level of productivity of cropland, grassland, and forest land will increase with the higher level of management made possible by the project.

Secondary benefits from a national viewpoint were not considered pertinent to the evaluation. Local secondary benefits in the amount of $3,093 will accrue as a result of increases in the sale of agricultural products and increased income to local processors, business establishments, and others not directly benefited. These local secondary benefits also include the transporting, processing, and marketing of these goods and services that produce the primary benefits, and the supply of additional materials and services required to make possible the increased net returns which stem from installation of the project.

COMPARISON OF BENEFITS AND COSTS

The average annual flood prevention benefits from the structural measures are estimated to be $33,378 primary benefits, and $3,093 secondary benefits, for a total of $36,471. The average annual cost, including $3,125 for operation and maintenance, is estimated to be $19,516. This gives a primary benefit-cost ratio for the structural measures of 1.7 to 1.0, and an overall benefit-cost ratio of 1.9 to 1.0. An analysis of these benefits and costs is shown in Table 6.

PROJECT INSTALLATION

The installation period of the project is eight years.

The soil and water conservation districts will assume the responsibility for getting land treatment measures established. The goals have been established in this work plan. This work has been scheduled on a yearly basis at the rate of 15 percent per year. The sponsors will review progress annually and give their full support to see that this phase is kept current with the structural works of improvement.

Land treatment measures will be applied by the landowners and operators on their farms at their own expense in cooperation with their respective soil and water conservation districts. The districts will make available technical assistance for the planning and application of these measures. P. L. 566 funds will be used to provide this assistance, including necessary soil surveys.

The soil and water conservation districts will prepare news releases, hold educational meetings, and conduct demonstrations and tours to provide motivation and publicity to landowners and operators. Close working relations will be maintained with the North Carolina State Highway Commission and the North Carolina Division of Forestry so that roadside erosion

control and woodland are adequately treated as planned.

Critical eroding areas of roadbanks will be vegetated by the Little Yadkin River Watershed Improvement Commission in Stokes County, the Surry County Watershed Improvement Commission in Surry County, and the Board of County Commissioners in Forsyth County in cooperation with the North Carolina State Highway Commission.

Critical silt source areas planned to be planted to grasses and legumes will be installed by landowners on a cost-sharing basis. P. L. 566 funds will pay the cost of material and the landowners will furnish labor and equipment.

Critical silt source areas planned to be planted to trees will be installed on a cost-sharing basis with the landowner furnishing material or services in kind equivalent to 20 percent of the installation cost. P. L. 566 funds will pay the remaining 80 percent of the installation cost. Private owners of forest land will apply and maintain other forestry measures on their own land.

The North Carolina Division of Forestry, in cooperation with the U. S. Forest Service, will assign a forester to this project for 18 months. The State and P. L. 566 funds will share in the costs for his services. If the State does not have the funds to share in the program, costs for the first year are provided by P. L. 566 funds. Cost-sharing rates in similar programs determine the cost-sharing rate during the remainder of the period. The present Cooperative Forest Management Program will continue throughout the installation period.

Structural works of improvement are scheduled to be installed the fifth and sixth project years.

The Little Yadkin River Watershed Improvement Commission will be responsible for acquiring and all costs of acquiring the needed land, easements and rights-of-way for structural works of improvement in Stokes County. The Board of County Commissioners will be responsible for acquiring and all costs of acquiring land, easements and rights-of-way for structural works of improvement in Forsyth County.

The Little Yadkin River Watershed Improvement Commission will let, bear the cost of, and administer contracts for all structural works of improvement to be installed in the watershed.

The Soil Conservation Service will provide, from P. L. 566 funds, the construction costs and the installation services of all structural works of improvement.

The Little Yadkin River Watershed Improvement Commission, the Surry County Watershed Improvement Commission, and the Board of County Commissioners in Forsyth have sufficient legal authority, including raising of

funds by levy or assessment, and the power of eminent domain to carry out their responsibilities of project installation and operation.

Inasmuch as this project is one construction unit, all land, easements and rights-of-way will be secured prior to the letting of contracts for structural works of improvement. Legal authority with power of eminent domain, necessary funds in hand, and an agreement to use such authority and funds may be substituted for easements where easements are not necessary for immediate construction.

FINANCING PROJECT INSTALLATION

Federal assistance for carrying out the works of improvement on non-Federal land, as described in this plan, will be provided under authority of the Watershed Protection and Flood Prevention Act, Public Law 566 (83d Congress, 68 Stat. 666), as amended. This assistance is contingent on the appropriation of funds for this purpose.

The soil and water conservation districts concerned shall obtain agreements to carry out recommended soil conservation measures and proper farm plans from owners of not less than 50 percent of the land situated in the drainage area above each retention reservoir to be installed with Federal assistance.

Prior to providing financial assistance for the construction of any planned structural measures at least 75 percent of the effective land treatment measures must be installed, or their installation commenced on those sediment source areas which, if uncontrolled, would require a material increase in the cost of construction, operation and maintenance of structural works of improvement.

All land, easements and rights-of-way necessary for the installation of planned works of improvement will be secured prior to issuance of invitation to bid for construction. Legal authority with power of eminent domain, necessary funds in hand, and an agreement to use such authority and funds may be substituted for easements where assessments are not necessary for immediate construction.

The North Carolina Legislature has authorized the Board of County Commissioners of Stokes, Surry and Forsyth Counties to participate in watershed protection and flood prevention projects. The Board of County Commissioners of Stokes County have appointed the Little Yadkin River Watershed Commission to assume their responsibilities. The Board of County Commissioners of Surry County have appointed the Surry County Watershed Improvement Commission to assume their responsibilities. In Forsyth County, the Board of County Commissioners are handling their watershed activities themselves. Stokes and Surry Counties have the power of taxation and eminent domain; Forsyth County has the power of eminent domain and can use county tax funds other than "ad valorem" taxes. Funds from these sources will be used as necessary for installation of the project.

Specific agreements for the maintenance of structural works of improvement will be executed prior to the issuance of invitation to bid. This agreement will cover such items as source of funds, method of providing maintenance, annual maintenance inspections, and responsibility for providing these funds and services.

Land treatment measures will be installed by landowners or operators utilizing whatever cost-sharing that is available under the Agricultural Conservation Program or other similar programs.

Critical area stabilization (grasses and legumes) will be installed jointly by landowners or operators and the county organization authorized to participate in watershed activities. The cost of installing these measures will be cost-shared by the landowners and P. L. 566 on the same basis as similar going programs.

Roadside erosion control will be installed by the county organization authorized to participate in watersheds and may negotiate with the North Carolina State Highway Commission for their assistance.

The sponsoring local organization, the North Carolina Division of Forestry, and the U. S. Forest Service will enter into a three-way agreement to install the critical area tree planting measures. P. L. 566 funds will pay the cost of technical assistance to be provided by the North Carolina Division of Forestry in installing critical area tree planting.

Technical assistance provided under P. L. 46 to soil and water conservation districts will be continued at the present rate. Accelerated technical assistance to plan and install land treatment measures will be provided by the Soil Conservation Service from P. L. 566 funds.

Technical assistance for the installation of forest land treatment measures will be provided from P. L. 566 funds and State funds on a predetermined cost-sharing basis.

The sponsoring local organizations expect to obtain practically all land, easements and rights-of-way by donations. Where individuals suffer major damages, the Little Yadkin River Watershed Improvement Commission is prepared to pay reasonable damages from funds secured from the Stokes County Board of Commissioners. These funds will be raised by a county-wide levy.

It is not anticipated that credit will be required. In the event that credit is needed, the Little Yadkin River Watershed Improvement Commission has the authority to negotiate a loan from the Farmers Home Administration and to repay the loan from funds raised by levy.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment

Land treatment measures for open land, including critical area plantings

of legumes and grasses, will be maintained by the landowners or operators of the land on which these measures are installed.

Maintenance of land treatment measures will be promoted and encouraged through the Soil and Water Conservation Districts' Program with technical assistance furnished by the Soil Conservation Service.

The North Carolina Division of Forestry, in cooperation with the U. S. Forest Service, will furnish technical assistance to operate and maintain forestry measures on private land. Landowners will perform the actual operation and maintenance.

Roadside erosion control planting will be maintained by the North Carolina State Highway Department as part of their regular road maintenance program.

Structural Measures

The Little Yadkin River Watershed Improvement Commission will operate and maintain the floodwater retarding structures and clearing and snagging in Stokes County, at an estimated annual cost of $800 and $2,100 respectively. The Board of County Commissioners of Forsyth County will provide the funds and the Forsyth Soil and Water Conservation District will operate and maintain clearing and snagging in Forsyth County at an estimated annual cost of $225.

All structural measures should be inspected after every major storm and will be inspected at least once a year. Representatives of the Little Yadkin River Watershed Improvement Commission and the Forsyth Soil and Water Conservation District will, with the Soil Conservation Service, make the required annual inspection. A report including recommendations for repairs, improvements and replacements will be prepared and filed for each inspection.

The structural works of improvement will be operated in such a manner that they will serve the purpose, both as to function and time, for which they were installed. The maintenance will consist of but not be limited to the following:

1. Remove and dispose of debris from principal and emergency spillways.

2. Refill, smooth and vegetate rilling on embankment, spillways, and drainage ways.

3. Repair fences, gates and other appurtenances.

4. Maintain good vegetative cover.

5. Channels will be kept free of debris and snags.

6. Woody growth on banks of channels will be curtailed.

7. Metal used in construction will be replaced as required for proper structural function.

Specific maintenance agreements will be entered into prior to the execution of the project agreement for works of improvement.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
LITTLE YADKIN RIVER WATERSHED

Stokes, Forsyth and Surry Counties, North Carolina

INSTALLATION COST ITEM	UNIT	Number Non-Federal Land	Est. Cost (Dollars)[1/] P.L. 566 Non-Federal Land	Other Non-Federal Land	Total
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	7,229		253,469	253,469
Grassland	Acre	2,175		93,213	93,213
Critical Area Stabilization:					
Grasses and Legumes	Acre	51	6,120	4,080	10,200
Roadside Erosion Control	Acre	51		12,750	12,750
Technical Assistance			185,296	11,755	197,051
SCS Subtotal			191,416	375,267	566,683
Forest Service					
Forest Land	Acre	6,095		34,210	34,210
Critical Area Stabilization:					
Tree Planting	Acre	200	9,900	2,500	12,400
Technical Assistance			10,420	5,100	15,520
FS Subtotal			20,320	41,810	62,130
TOTAL LAND TREATMENT			211,736	417,077	628,813
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Stru.	No.	3	268,908		268,908
Clearing and Snagging	Ft.	163,650	54,985		54,985
Subtotal - Construction			323,893		323,893
Installation Services					
Engineering			64,779		64,779
Other			25,264		25,264
Subtotal - Instal. Services			90,043		90,043
Other Costs					
Land, Easements & R/W				83,895	83,895
Administration of Contracts				2,500	2,500
Subtotal - Other				86,395	86,395
TOTAL - STRUCTURAL MEASURES			413,936	86,395	500,331
TOTAL PROJECT			625,672	503,472	1,129,144
SUMMARY					
Subtotal - SCS			605,352	461,662	1,067,014
Subtotal - FS			20,320	41,810	62,130
TOTAL PROJECT			625,672	503,472	1,129,144

1/ Price Base: 1964 Date: June 1965

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

LITTLE YADKIN RIVER WATERSHED

Stokes, Forsyth and Surry Counties, North Carolina

Measures	Unit	Applied to Date	Total Cost (Dollars) 1/
Conservation Cropping System	Ac.	2,000	6,000
Contour Farming	Ac.	2,000	6,000
Cover Crop	Ac.	188	940
Crop Residue Use	Ac.	3,929	11,787
Diversion	Ft.	20,300	1,015
Drainage Field Ditch	Ft.	3,200	160
Farm Pond	No.	42	21,000
Grasses & Legumes in Rotation	Ac.	1,000	15,000
Grassed Waterway	Ac.	81	8,100
Pasture Proper Use	Ac.	400	800
Pasture & Hayland Renovation	Ac.	100	5,000
Pasture & Hayland Planting	Ac.	2,535	253,500
Stripcropping	Ac.	25	50
Terracing	Ft.	634,822	19,045
Wildlife Habitat Development	Ac.	2	100
Woodland Intermediate Cutting	Ac.	30	150
Woodland Underplanting	Ac.	10	220
Woodland Weeding	Ac.	10	280
Woodland Intermediate Planting	Ac.	50	1,100
TOTAL			350,247

1/ Price Base: 1964 Date: June, 1965

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

LITTLE YADKIN RIVER WATERSHED

Stokes, Forsyth and Surry Counties, North Carolina

(Dollars) 1/

Structure Site No. or Name	Installation Cost - P. L. 566 Funds				Installation Cost - Other Funds			
		Instal. Services			Other			
	Con-struc-tion	Engin-eering	Other	Total P. L. 566	Adm. Con-tracts	Ease-ments & R/W	Total Other	Total Installa-tion Cost
Floodwater Retarding Str. #2	97,957	19,591	7,641	125,189	500	37,150	37,650	162,839
Floodwater Retarding Str. #4	108,013	21,603	8,425	138,041	500	15,650	16,150	154,191
Floodwater Retarding Str. #6	62,938	12,588	4,909	80,435	500	16,040	16,540	96,975
Subtotal - Floodwater Retard-ing Str.	268,908	53,782	20,975	343,665	1,500	68,840	70,340	414,005
Clearing and Snagging								
Little Yadkin River	22,226	4,445	1,734	28,405	404	6,085	6,489	34,894
East Fork	9,552	1,910	745	12,207	174	2,615	2,789	14,996
West Fork	9,438	1,888	736	12,062	171	2,585	2,756	14,818
Danbury Creek	4,089	818	319	5,226	75	1,120	1,195	6,421
Crooked Run Creek	9,680	1,936	755	12,371	176	2,650	2,826	15,197
Subtotal - Clearing and Snagging	54,985	10,997	4,289	70,271	1,000	15,055	16,055	86,326
TOTAL	323,893	64,779	25,264	413,936	2,500	83,895	86,395	500,331

Price Base: 1964

Date: June, 1965

TABLE 3 - STRUCTURE DATA

Floodwater Retarding Structures

LITTLE YADKIN RIVER WATERSHED

Stokes, Forsyth and Surry Counties, North Carolina

ITEM	UNIT	STRUCTURE NUMBERS 2	4	6	TOTAL
DRAINAGE AREA	sq.mi.	6.60	4.91	2.18	13.69
STORAGE CAPACITY					
Sediment - submerged	ac.ft.	421	322	144	887
Sediment - aerated	ac.ft.	448	349	183	980
Floodwater	ac.ft.	1,150	775	483	2,408
TOTAL	ac.ft.	2,019	1,446	810	4,275
Between high & low stages 2/	ac.ft.			262	262
SURFACE AREA					
Sediment pool	ac.	44	29	24	97
Floodwater pool	ac.	129	79	67	275
Evaluation of sediment pool	ft.	979.5	924.0	962.0	xxxxx
Depth of sediment pool	ft.	24.5	29.0	18.0	xxxxx
VOLUME OF FILL	cu.yds.	157,900	125,000	83,000	365,900
EVALUATION TOP OF DAM	ft.	1003.0	949.0	984.0	xxxxx
MAXIMUM HEIGHT OF DAM	ft.	55.5	61.5	44.0	xxxxx
EMERGENCY SPILLWAY					
Crest Elevation	ft.	999.0	945.5	976.5	xxxxx
Bottom Width	ft.	150	100	220	xxxxx
Type		Veg.	Veg.	Veg.	xxxxx
Percent chance of use		4	4	1	xxxxx
Avg. Curve No. - Cond. II		79	76	76	xxxxx
EMERGENCY SPILLWAY HYDROGRAPH					
Storm rainfall (6-hr.)	in.	5.20	5.20	11.35	xxxxx
Storm runoff	in.	2.98	2.70	8.28	xxxxx
Velocity of flow (V_c) 1/	ft/sec.			5.52	xxxxx
Discharge rate 1/	c.f.s.			2,805	xxxxx
Max.w.s. elev. 1/	ft.			979.0	xxxxx
FREEBOARD HYDROGRAPH					
Storm rainfall (6-hr.)	in.	8.05	8.05	28.80	xxxxx
Storm runoff	in.	5.56	5.20	25.32	xxxxx
Velocity of flow (V_c) 1/	ft/sec.	6.97	7.91	11.27	xxxxx
Discharge rate 1/	c.f.s.	2,550	1,730	13,300	xxxxx
Maximum w.s.elev. 1/	ft.	999.5	945.0	984.0	xxxxx
PRINCIPAL SPILLWAY					
Capacity-low stage	c.f.s.	----	----	33	xxxxx
Capacity-high stage	c.f.s.	108	116	110	xxxxx
CAPACITY EQUIVALENTS					
Sediment Volume	in.	2.47	2.56	2.81	xxxxx
Detention Volume	in.	3.27	2.96	4.15	xxxxx
Spillway Storage	in.	1.44	1.12	5.16	xxxxx
CLASS OF STRUCTURE		A	A	C	xxxxx

1/ Maximum during passage of hydrograph Date: June, 1965

2/ Net

TABLE 3A - STRUCTURE DATA - CHANNELS

LITTLE YADKIN RIVER WATERSHED

Stokes, Forsyth and Surry Counties, North Carolina

Channel Designation	Sta. Numbering for Reach Sta. (ft.)	Sta. (ft.)	Net Watershed Area (sq.mi.)	Planned Channel Capacity (c.f.s.)	Remarks
Main Stem:					
Reach C	334+20	404+20	22.00	2,900	Clearing and Snagging
Reach B	404+20	812+30	40.19	2,900	Clearing and Snagging
Reach A	812+30	995+70	48.81	3,100	Clearing and Snagging
East Prong:					
Reach D	50+00	334+20	7.93	1,200	Clearing and Snagging
West Prong:					
Reach F	50+00	241+40	11.43	1,700	Clearing and Snagging
Reach E	241+40	330+90	13.18	1,200	Clearing and Snagging
Danbury Creek:					
Reach G	50+00	171+70	8.22	420	Clearing and Snagging
Crooked Run:					
Reach H	50+00	338+10	5.84	460	Clearing and Snagging

Note: The average "n" value used for clearing and snagging was 0.072 or an average reduction of 15 percent from present conditions.

Date: June, 1965

TABLE 4 - ANNUAL COST

LITTLE YADKIN RIVER WATERSHED
Stokes, Forsyth and Surry Counties, North Carolina

(Dollars)

Evaluation Unit	Amortization of Installation Cost 1/	Operation and Maintenance Cost 2/	TOTAL
All Structural Works of Improvement	16,391	3,125	19,516
TOTAL	16,391	3,125	19,516

1/ Price Base: 1964, Interest rate at 3-1/8 percent for 100-year amortization period.

2/ Projected Prices.

Date: June, 1965

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

LITTLE YADKIN RIVER WATERSHED

Stokes, Forsyth and Surry Counties, North Carolina

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Crop and Pasture	18,325	1,000	17,325
Minor and Major Fixed Improvements	11,000	1,300	9,700
Subtotal	29,325	2,300	27,025
Sediment			
Infertile Deposition	1,840	340	1,500
Subtotal	1,840	340	1,500
Indirect	3,117	264	2,853
TOTAL	34,282	2,904	31,378

1/ Price base: Long term projected. Date: June, 1965

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

LITTLE YADKIN RIVER WATERSHED, NORTH CAROLINA

(Dollars) 1/

Evaluation Unit	AVERAGE ANNUAL BENEFITS				Average Annual Cost	Benefit Cost Ratio
	Flood Prevention					
	Damage Reduction	More Intensive Land Use	Secondary	Total		
All Structural Works of Improvement	28,378	5,000	3,093	36,471	19,516	1.9:1.0
GRAND TOTAL	28,378 2/	5,000	3,093	36,471	19,516	1.9:1.0

1/ Price base: Benefits are long term projected and cost 1964 - (See Table 4).

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $3,000.

Date: June, 1965

INVESTIGATIONS AND ANALYSES

Land Use and Treatment

The present status of land treatment was determined by tabulating data recorded on individual farm plan records. These plans represent 30 percent of the area.

In determining the present cover conditions, a quality cover survey was made of about 40 percent of the open land area of the watershed. Woodland cover conditions were determined by the U. S. Forest Service using a systematic sampling system. Data from these areas were tabulated and expanded to cover the entire watershed.

Major land uses were determined in making the cover data survey. Soil surveys were available for about 23 percent of the watershed area. This data was consolidated to give the acreage of land by capability units and land use. Determinations were made of the land treatment measures that would be needed to adequately treat a composite acre for each of the capability units. These findings were then presented to the sponsoring local organizations who decided on the amounts to be included in the work plan.

Engineering

Aerial photographs, on a scale of 3.168 inches per mile, were secured of the watershed. The drainage system was stereoscopically superimposed on the photographs and a watershed mosaic developed. This mosaic was then used as a base for a blue line watershed map. Identifying information such as churches, schools, named crossroads, etc. were also shown.

All marked U.S.G.S. bench marks, including third order surveys, were recorded on work copy of the watershed map. Additional bench marks were set on bridges, crossroads and other key points throughout the watershed. Temporary bench marks set by the Soil Conservation Service are 3" x 5" aluminum plates. These temporary bench marks are also shown on work copy of the watershed map.

Potential floodwater retarding sites were selected stereoscopically and then field checked for foundation conditions, spillway locations and availability of fill material. Sites were selected on five tributaries with one or more alternate sites selected on three of the tributaries.

Stream channels were investigated in the field to determine the extent of channel fill, channel scour, debris deposits and the "n" values to be used in hydraulic calculations. Data so collected was used to determine the extent of stream channel improvement.

Five sites were then surveyed by ground control methods and topographic maps prepared. Stage-storage and stage area curves were then prepared for each site. Centerline surveys of each site were also plotted. Preliminary designs were then prepared for each of the floodwater retarding structures, using criteria as established in Engineering Memoranda-27, -31 (Revised), NC-15 and Technical Release No. 2. Emergency spillway designs, depth of flow in the emergency spillway for the freeboard hydrograph and the detention volume requirements were determined by methods described in the above Soil Conservation Service memoranda.

Floodwater retarding structures were assigned hazard classifications commensurate with the hazard to property and life which could be endangered by the structure. All structures were designed to store 100-year sediment production. (See Table 3 for design data.)

Floodwater retarding structures Nos. 2, 3, and 4 were designed with side slopes of 3.0 to 1.0 and structures Nos. 6 and 7 were designed with side slopes of 2.5 to 1.0. A ten foot berm was designed on the upstream side at the sediment pool water level. All of the disturbed area above the sediment pool elevation will be vegetated.

Principal spillways for all structures will be of reinforced concrete pipe. Their capacity was designed to provide a release rate which would be retained within channel banks yet would release the flood storage in ten days or less. A two-stage inlet is planned for floodwater retarding structure No. 6 due to the small drainage area above the structure, the minimum allowable pipe size and the downstream channel capacity.

Emergency spillways were designed to be of vegetated earth. The size was determined by a short cut flood routing procedure.

Acreage of land in the sediment pools and detention pools were measured by land use. This data was furnished to the Little Yadkin River Watershed Improvement Commission who placed the follar value of easements. Road modification costs were estimated by the North Carolina State Highway Department.

Stream channel improvement consisting of clearing and snagging will require a minimum of right-of-way. This Little Yadkin River Watershed Improvement Commission will secure sufficient right-of-way for access and to dispose of woody material removed from the channels. As in the case of floodwater retarding structures, the Watershed Improvement Commission placed the dollar value of right-of-way for channel improvement.

Alternate designs were made of floodwater retarding structures until the most economical combination of emergency spillway and embankment was found. This was used for cost estimate.

The operation and maintenance cost of floodwater retarding structures was estimated at $300 for structures costing $100,000 or more and $200 for

those costing less than $100,000. Operation and maintenance cost of clearing and snagging of channels is based on the jobs to be performed annually.

Hydrologic and Hydraulic Analysis

The watershed has a drainage area of 40,000 acres (62.50 square miles). The three floodwater retarding structures considered in the analysis, with drainage areas ranging from 2.18 to 6.60 square miles, control 13.69 square miles or about 22 percent of the total watershed area. Structural works of improvement on two reaches of the watershed West Prong and Danbury Crook, will be limited to clearing and snagging.

Eight evaluation reaches were used in the analysis. The 1,047 acres of flood plain, protected by structural measures and/or clearing and snagging, were represented by 26 valley cross sections. The maximum flood plain acreage was determined by stereoscopic delineation, and was checked against the 50-year regionalized storm.

Rainfall amounts used in developing the historical storm series were taken from local climatological data. The entire watershed was represented by five Weather Bureau Stations, with a minimum of two gages in operation at any one time. Rainfall distribution was made by averaging the rainfall amounts for all stations, and was checked against isohyetal maps for the annual storm series.

Soil-cover-complex runoff curve numbers were computed for each individual structure site, and for the watershed as a whole. Soil and cover conditions for three sample areas, or 23 percent of the total watershed, were mapped for this purpose. Runoff curve numbers for the wooded areas were furnished by the U. S. Forest Service.

Flood routing was done by the Storage Indication Method. Weighted runoff amounts were plotted versus the routed peak discharges in order to obtain the discharge per unit volume of runoff. Runoff-stage relationships were then developed, and used to determine the stage produced by each storm in the historical series. Peak discharge values within a given routed reach were estimated by the concordant flow procedure. Hydrograph computations were made by the peak rate equation and storm durations were estimated from local recording gage records.

Stage-discharge relationships were computed by Mannings' formula. Roughness coefficients, for use in computing rating curves, were estimated in accordance with the procedure outlined in Supplement B to Section 5 of the National Engineering Handbook. Stream channel profiles were plotted, and used to determine the slope of the hydraulic grade line.

Acres inundated by depth increments and total acres inundated were computed for each of the evaluation reaches. These computations were then used to obtain the total acres inundated and depths of inundation for each of the 33 damage producing storms in the 16-year historical series.

Storage requirements for structures were computed in accordance with Engineering Memorandum NC-15, and checked against Engineering Memorandum SCS-67. The 48-hour base criteria (Engineering Memorandum NC-15) governed the design of structures Nos. 2, 3 and 7 and the six-hour storm (Engineering Memorandum-27) governed the design of structures Nos. 4 and 6. Emergency spillway and freeboard design hydrographs were computed in accordance with Engineering Memorandum-27.

Sedimentation Investigation

Determination of sediment damages was accomplished by field examination of the entire flood plain area. Percent of damage was determined by comparing damaged areas to undamaged areas within the same fields. Damage reductions were determined by estimating recovery periods.

Rates of soil movement and sediment production from sheet erosion were determined by using Musgrave's Formula 1/ which takes into account soil decline, percent of slope, length of slope, rainfall, and cover conditions. Data for the formula were obtained from weighed acreage measurements of soil surveys of the watershed. Rates were determined for each land resource area and for each land use respectively. Cover factors used in the determination of future rates of soil movement were computed from anticipated use of the land in the future. Three sample areas, comprising 23,000 acres, were analyzed in detail to determine extent of sheet erosion in the watershed. About 77 percent of the total soil movement is from sheet erosion.

Rates of soil movement and sediment production from channel type erosion were determined by delineating critical gullied areas and roadbanks on aerial photographs and then determining the annual rate of cutting. About 23 percent of the total soil movement is from channel erosion. Total sediment damages were determined in each case for the reach under consideration in terms of area contributing to that reach. Streambank erosion is not a serious problem in this project. The average annual erosion rate for all sources is nearly 3.5 tons per acre.

Sediment storage was computed separately for each floodwater retarding structure. An analysis was made of the cover complex, sheet erosion, and channel erosion on the watershed controlled by each individual structure. The total soil movement was determined and appropriate delivery rates were applied to calculate sediment storage requirements. Based on reservoir studies in the Piedmont of North Carolina, the delivery rates for this watershed should be about 25 percent of the soil movement. About 80 percent of the sediment will be deposited in the sediment pool and 20 percent in the detention pool.

Channel investigations were made by hand auger borings and by visual investigation of nearly all of the channels in the watershed.

1/ Musgrave, G. W., "The Quantative Evaluation of Factors in Water Erosion," Journal of Soil and Water Conservation.

Geologic Investigations

A preliminary site investigation was made of five sites that were evaluated during the planning phase of the watershed. Hand augers were used to study overlying material and depth to bedrock in borrow areas and in the foundation. At all sites the channel is down to hard rock. Adequate borrow material was located at each site.

Most of the watershed is underlain by the Kings Mountain group which is composed of quartzite, gneiss, and schist. Weathering is shallow in the areas underlain by quartzite. However, all three dams proposed in the plan are located where the emergency spillway can be excavated through weathered gneiss and schist, and little or no rock excavation will be encountered in the construction of the spillway. The rock surface in the foundation is uneven, and some rock excavation will be necessary in the installation of the conduits. Most of the borrow material will come from the emergency spillways or from the colluvial benches in the pool areas. The weathered rock from the emergency spillways will break down into SM and ML. This material will be high in mica content. Material from the pool will be SM, ML, and SC, and this should be the best core material.

A complete detailed foundation investigation is recommended for all sites for construction design.

The overall study of surface features was made to determine the general geology of the area.

Economics

Land use and yield information used in the economic evaluation of the agricultural areas of this watershed was obtained from interviews with farmers who operate 50 percent of the crop and pasture land in the flood plain. Basic data pertaining to the watershed was obtained from local farmers, farm machinery dealers, agricultural workers, experiment stations, and Department of Agriculture publications.

Damageable values, stage-area relationships, flood series, and depth and duration of inundation were considered in estimating average annual damages with and without the project. The historical flood series method was used to estimate agricultural damages. Frequency analysis was used to evaluate damages to fixed improvements in the flood plain. Adjustments were made for recurrent flooding. Value of land, easements and rights-of-way involved in structural works of improvement were determined by the sponsoring local organizations and concurred in by the Service.

Estimates of production cost, operation and maintenance cost, and benefits are based on long-term projected prices with calculations based on the use of a three and one-eighth percent interest rate and a 100-year evaluation period.

A conservation survey of sample areas in the watershed was completed by soil scientists of the Soil Conservation Service in 1958 by use of the sampling method developed by the Ames Statistical Laboratory, Ames, Iowa. The survey furnished information as to soil types, slope, degree of erosion, and major land use. This information was used to determine the number of acres in each soil type, slope, erosion, and capability class.

Methods and procedures contained in the Economic Guide for Watershed Protection and Flood Prevention were followed in the calculation of estimated floodwater damages to crops and pasture, and major and minor fixed improvements. Such procedures were also followed in arriving at estimates of benefits.

Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation.

Local secondary benefits were recognized and computed as follows:

SECONDARY BENEFITS

Estimates of Secondary Benefits	Amounts	Secondary Benefits
Direct Primary Benefits	$30,525 x 10%	$3,053
Annual Associated Cost	$ 400 x 10%	40
		$3,093

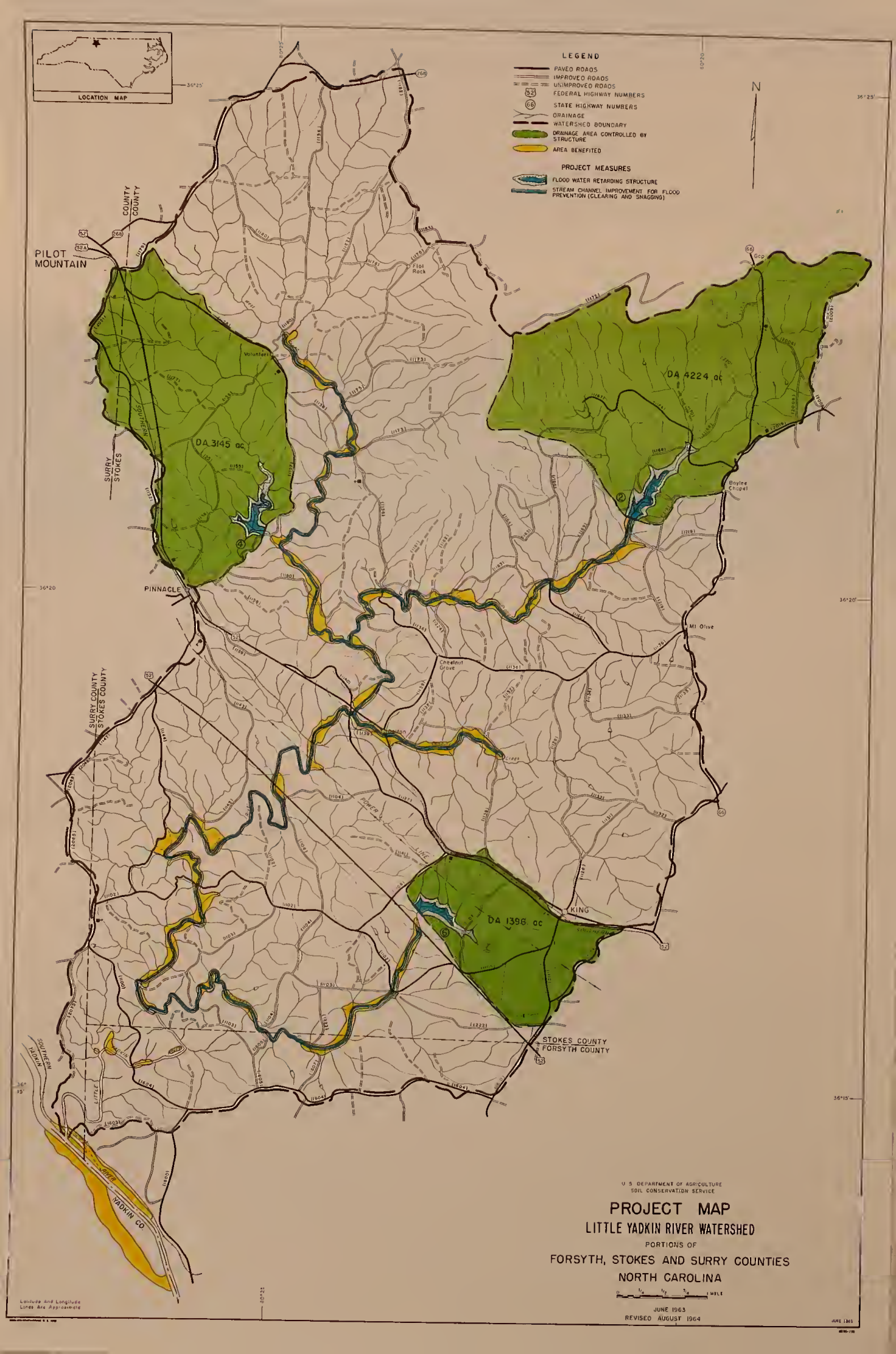
Added crop and pasture costs were not included in secondary benefits computation as there will be no net increase in crop production in the watershed.

Incidental recreation benefits from the use of the project works of improvement by organized groups and the general public were computed in accordance with procedures outlined in Watershed Memorandum 57, dated October 3, 1962.

Field surveys were made to determine existing facilities and the expected number of visitor-days of annual use. Landowners involved were interviewed to ascertain area to be set aside for recreational use, planned facilities, and maintenance policies. Population and population trends were computed within a 50-mile zone of influence.

Accessibility, available service facilities, recreational capacity, and admission levels were considered in arriving at the number of visitor-days to use. Field surveys reveal that limited basic facilities such as access roads, parking areas, picnic areas, and fishing and swimming areas are planned at each site.

With planned facilities and proper maintenance, it is estimated that there will be 2,160 visitor-days per year. These 2,160 visitor-days will yield an annual net incidental recreation benefit of $2,160 after all costs, including non-project associated costs, are deducted. These benefits are not used for project justification.



U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT MAP

LITTLE YADKIN RIVER WATERSHED

PORTIONS OF

FORSYTH, STOKES AND SURRY COUNTIES

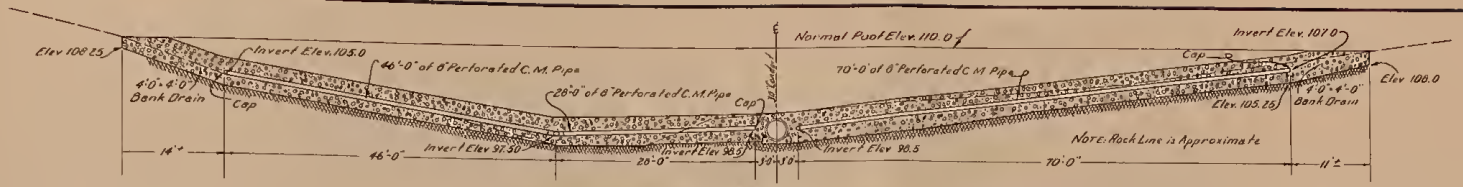
NORTH CAROLINA

0 1/4 1/2 3/4 1 MILE

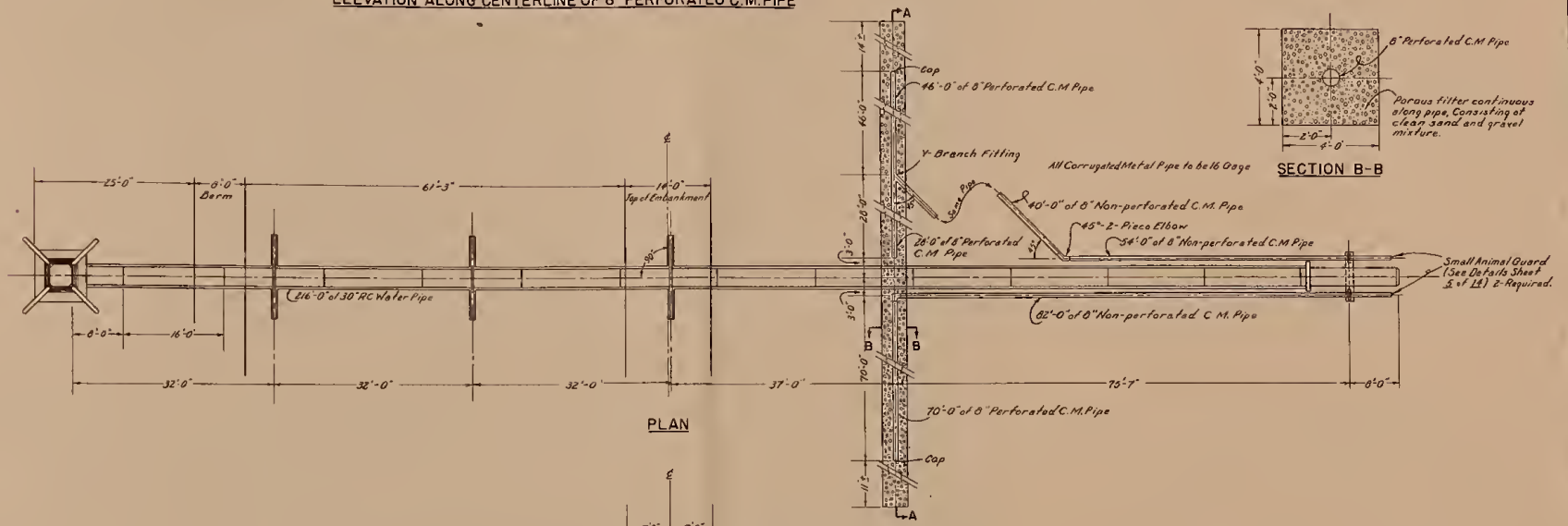
JUNE 1963

REVISED AUGUST 1964

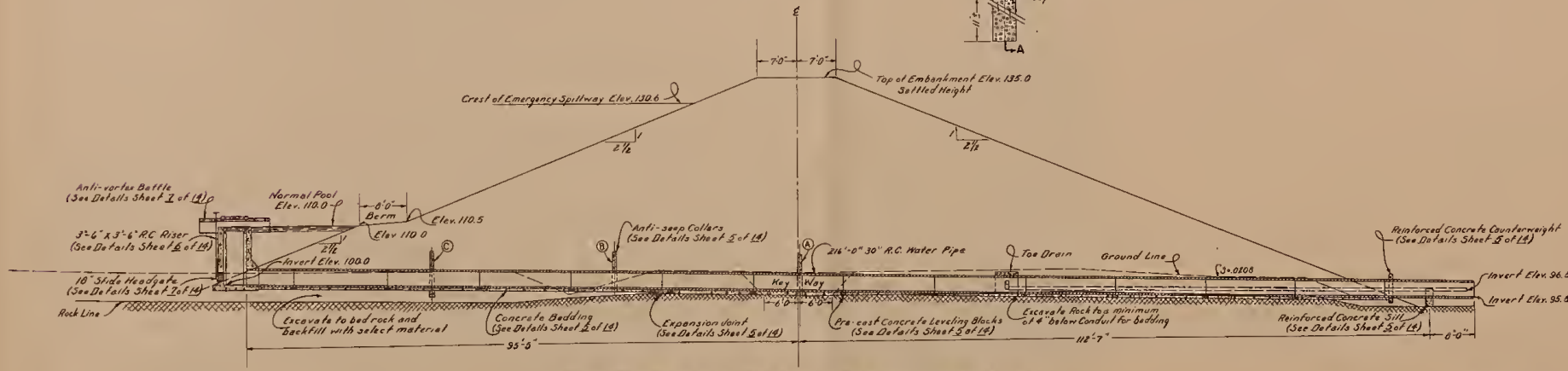
Latitude And Longitude Lines Are Approximate



SECTION A-A
ELEVATION ALONG CENTERLINE OF 8" PERFORATED C.M. PIPE



PLAN



SECTION ALONG CENTERLINE OF 30" REINFORCED CONCRETE PIPE
STA. 4+33 CENTERLINE OF DAM

PLAN
TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed		Approved by	
Drawn		Title	STATE CONSERVATION ENGINEER
Traced		Title	S.C.S. DESIGN ENGINEER
Checked		Sheet No. of	Drawing No.

HR56-201